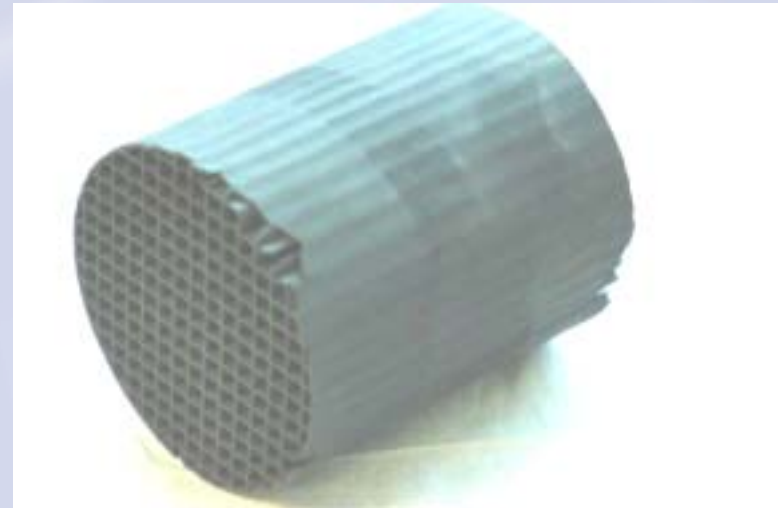


Catalytic Oxidation of Mercury for Enhanced Control across Wet FGD Absorbers

URS Corporation
Austin, TX



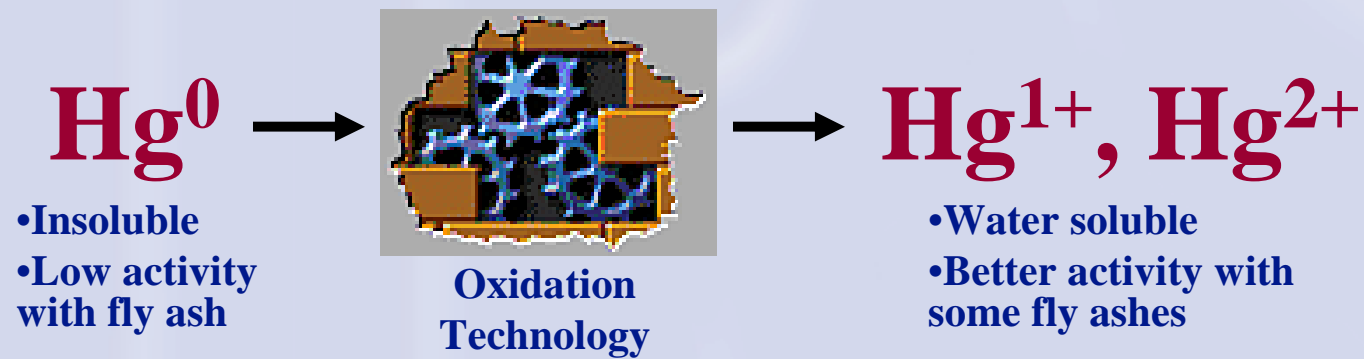
EPRI



URS

Mercury Oxidation Technologies

Objective: Enhance Mercury Removal by Increasing Flue Gas Mercury Oxidation

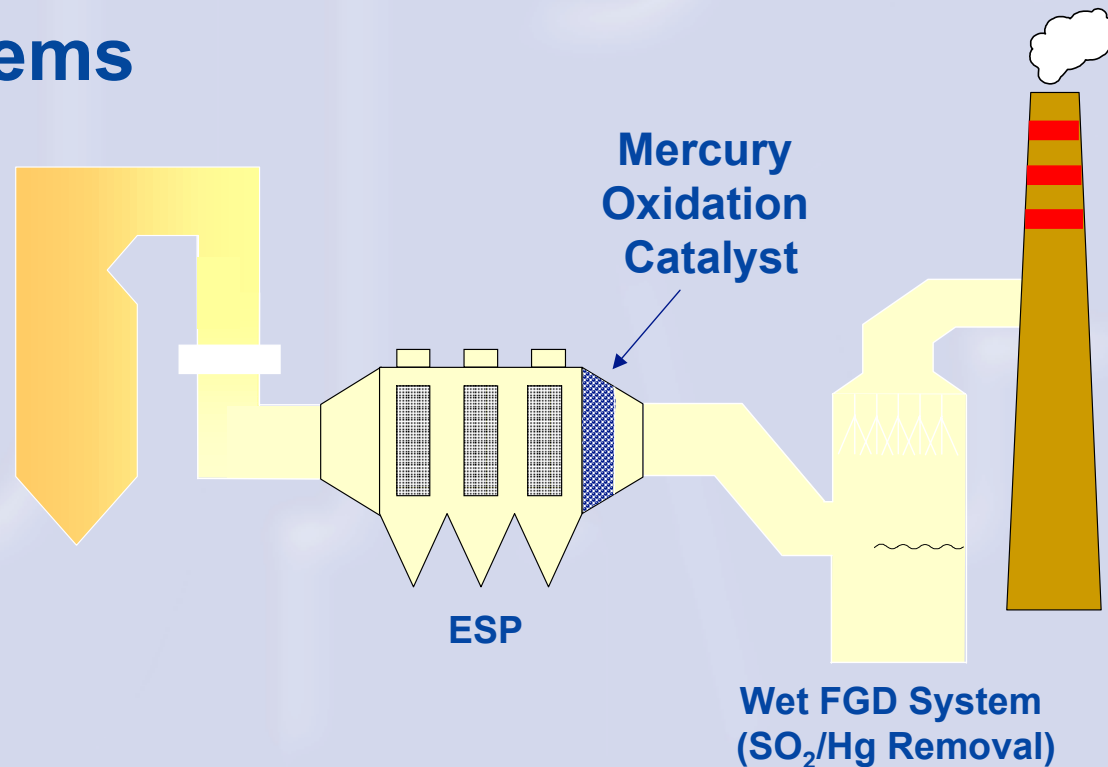


- **Mercury reports to byproduct solids**
 - Enhanced mercury removal across wet or dry scrubbers
 - Increased removal with fly ash

Catalytic Oxidation Process Technology Concept

Process

- Fixed catalysts used to oxidize Hg^0 in flue gas to increase removal across wet FGD systems



Catalytic Oxidation Process Development Background

- Initial concept development funded by EPRI
- DOE NETL/ EPRI co-funded MegaPRDA Project
 - 6-month catalyst exposure tests at 3 coal-fired sites (completed in 2001)
- DOE/NETL, EPRI, utility co-funded program
 - On-going DOE cooperative agreement program
 - Pilot evaluations of catalytic oxidation process

Project Team



Bruce Lani
Project Manager



Mark Strohfus
Loren Loritz



Al Lee



Dick Rhudy



Gary Blythe

Current Project

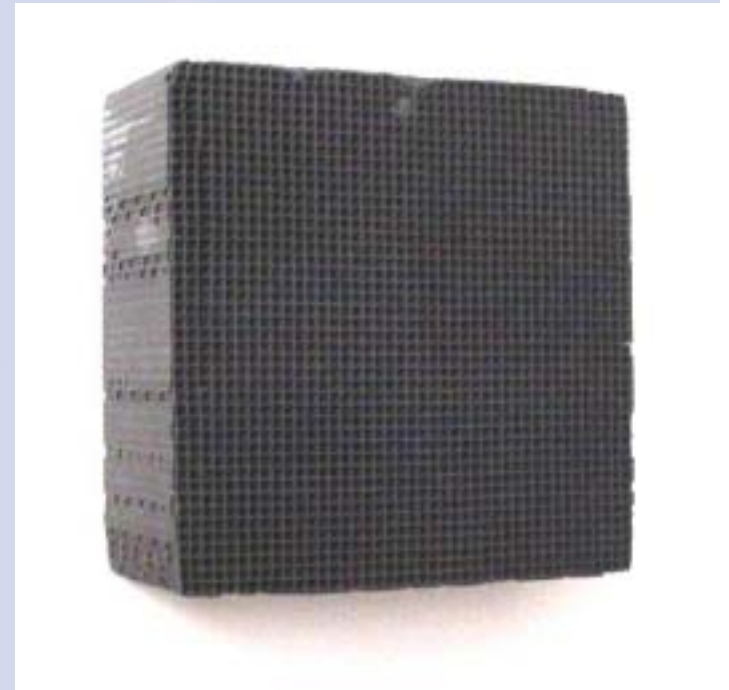
- **Pilot-scale tests of honeycomb Hg⁰ oxidation catalysts at two sites**
 - 4 catalysts tested in parallel (2000 acfm each)
 - 14-months automated operation at each site
 - Monthly activity measurements with Hg SCEM
- **Host sites:**
 - GRE Coal Creek Station (ND lignite)
 - pilot test started 10/02
 - CPS J.K.Spruce Plant (PRB coal)
 - pilot test to start summer '03

Catalyst Selection for Pilot Unit

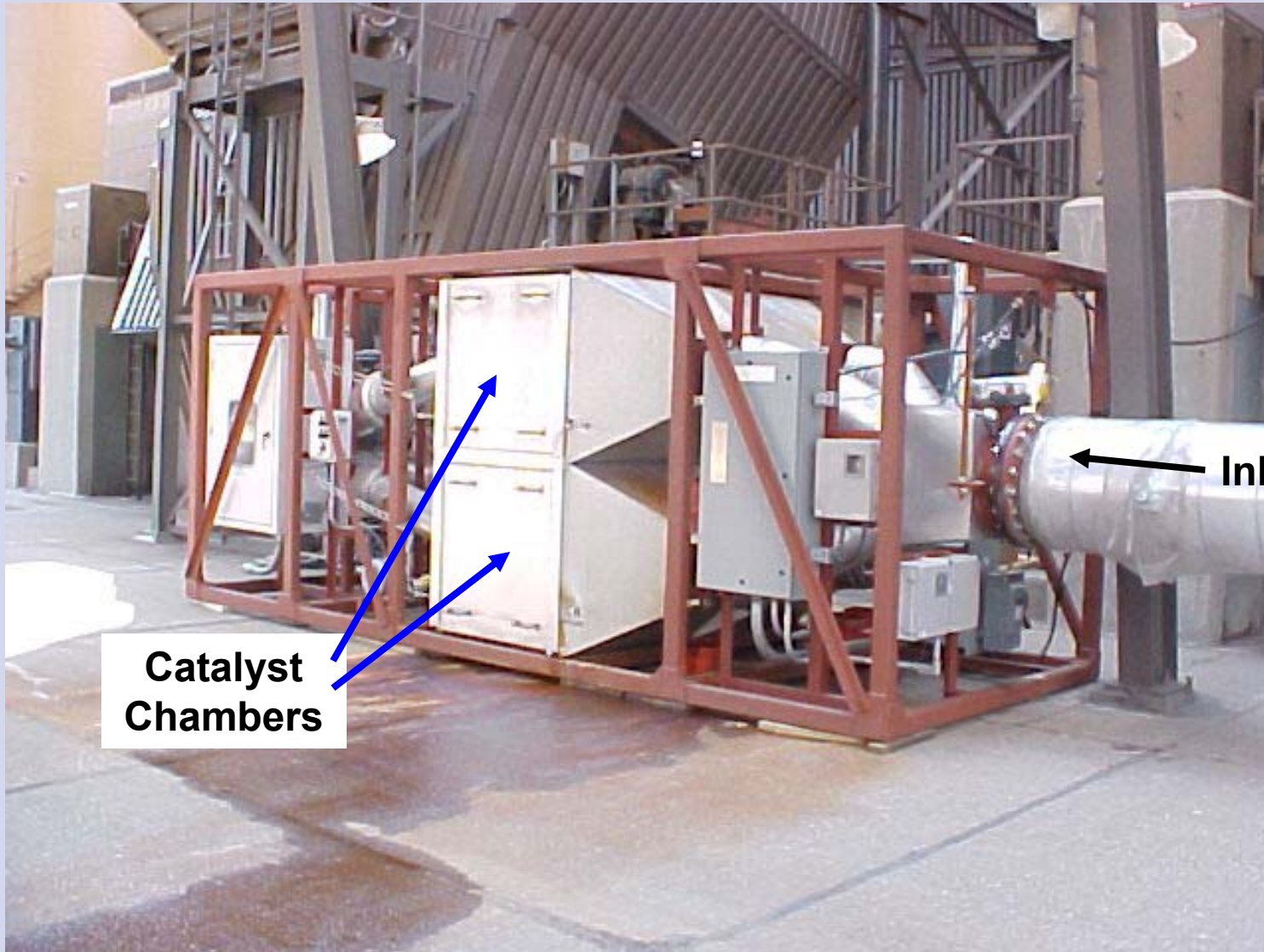
- **Hg oxidation performance in actual flue gas**
 - Candidate catalysts identified from previous MegaPRDA sand-bed field tests
- **Honeycomb catalyst activity measured in laboratory**
 - Simulated flue gases at Coal Creek and Spruce
- **Mass transfer model**
 - Project pilot catalyst performance as a function of catalyst cell pitch, cross section, length

Catalyst Types Evaluated - CCS

- **Metal-based**
 - Palladium (Pd #1) [10/02]
 - Ti/V (SCR) [10/02]
- **Carbon-based**
 - Experimental activated carbons (C #6) [6/03]
- **Fly-ash-based**
 - High LOI subbituminous ash (SBA #5) [12/02]



Pilot Test Unit Installed at Coal Creek Station



**Catalyst
Chambers**

Inlet Gas

Catalyst Dimensions Selected for Coal Creek Pilot Unit

Catalyst	Cells per in. ² (cpsi)	Cross Section (in. x in.)	Length (in.)	Area Velocity (sft/hr)
Pd #1	64	30 x 30	9	49
C #6	64	36 x 36	9	33
SBA #5	64	36 x 36	9	33
SCR (Agillon Gmbh)	46	35.4 x 35.4	19.7	19

Agillon Gmbh SCR Catalyst



SBA #5 Catalyst Module

One of Three



Initial Pilot Catalyst Activity

(October 02)

Flue Gas Rate (acfm)	Inlet Hg Oxidation (%)	Pd #1		SCR	
		Hg ⁰ Ox. (%)	Area Vel. (sft/hr)	Hg ⁰ Ox. (%)	Area Vel. (sft/hr)
1500	43	95	37	67	14
2000	32	93	49	62	19
2300	42	89	56	61	22

Highlighted values represent selected long-term catalyst operating conditions

Catalyst Activity Results

Catalyst (Flow Rate, acfm)	Hg ⁰ Oxidation across Catalyst (%)			
	Oct02	Dec02	Jan03	Jan03 (after cleaning)
Pd #1 (2000)	93	53	58	91
SCR (1500)	67	28	37	61
SBA #5 (2000)	na*	na*	59	75

Efforts to Resolve Ash Buildup

- **Sonic horns installed to control buildup**
 - **Analytec 17" horn**
 - **Initially installed on Pd #1 chamber**
 - **good results for ΔP , Hg oxidation**
 - **Recently installed on remaining chambers**

Catalyst Activity Results - Pd #1

Date	Hg ⁰ Oxidation Across Catalyst (%)
October 02	93
December 02	53
January 03	58
January 03 (after cleaning)	91
March 03 (after cleaning)	93
April 03 (with sonic horn)*	89
June 03	92

*Confounded by Hg adsorption

Flue Gas Characterization

Hg Results - Oct02

- **Ontario Hydro measurements on pilot unit inlet/outlets, full-scale wet FGD**
 - **Confirmed catalyst oxidation results measured with EPRI semi-continuous Hg analyzer**
 - **Confirmed low oxidation percentage in ESP outlet flue gas (e.g., pilot unit inlet)**
 - **High removal of oxidized Hg, little or no Hg⁰ re-emissions across CCS FGD absorber**

Flue Gas Characterization

Results - Oct02

- **Controlled Condensation results showed no oxidation of SO₂ across Pd#1, SCR catalysts**
 - Catalyst inlet and outlet SO₃ ~0.1 ppmv
- **Draeger tubes showed little or no oxidation of NO across either catalyst**
 - Analyzer measurements planned for all catalysts
- **M26a showed no change in HCl or HF across catalysts**

Current Program Schedule

- **Coal Creek tests to continue through 2003**
 - Effect of exposure time on performance
 - Scrubber removal of catalyst-oxidized Hg (EPRI)
 - Catalyst regeneration (if needed)
- **Second pilot unit currently at Spruce plant**
 - Installation at ID fan outlet early June
 - Expect startup summer 03 with Pd, SCR, 2 other)